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“Collective C2 in Multinational Civil-Military Operations”

Enhancing Collective C2 in the International Environment:
Leveraging the Unclassified Information Sharing Enterprise Service

Topics:

- 1) C2, Management, and Governance in Civil-Military Operations
- 2) Networks and Networking
- 3) Information and Knowledge Exploration

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ABSTRACT

The Indian Ocean Basin Tsunami in December 2004 underscored the requirement for a collaborative environment amongst military and civilian actors from across the international environment. United States Pacific Command (USPACOM) had been hosting the Asia Pacific Area Network (APAN) to support the Multinational Planning Augmentation Team (MPAT). At first it was less a network than a nominal Website and it evolved into a portal where, upon conclusion of Operation Unified Assistance, it had become evident that the Department needed to invest in Web-based portal technologies to foster collaboration through social networking and to improve information sharing. The Transnational Information Sharing Cooperation (TISC) Joint Concept and Technology Demonstration (JCTD) accomplished that by September 2009 where it concluded with a resultant portal called the All Partner Access Network – a *new* APAN. The new APAN was given a trial by fire as it underwent user acceptance in conjunction with Operation Unified Response – the USSOUTHCOM HA/DR operation responding to the January 2010 earthquake in Haiti. This paper examines how APAN, the basis for the Department’s Unclassified Information Sharing (UIS) Enterprise Service, is emerging as the bridge between the US military and non-traditional mission partners as well as the bridge between the present and the future Unclassified Information Sharing (UIS) capability.

Keywords: information sharing, C2, command and control, UIS, civil-military operations, APAN, Web 2.0, social networking applications

1. Introduction

In the aftermath of the Indian Ocean Basin Tsunami in 2004, it became quite evident that the U.S. Department of Defense was in need of a mechanism to share unclassified information amongst a wide variety of non-traditional mission partners including international organizations (IOs), non-governmental organizations (NGO's), coalition militaries, and with multiple nations. It was not precisely known exactly what type of system, capability, or mechanism was required. However, there were lessons learned that suggested a traditional Web site was insufficient. Clearly what was needed was a collaborative information environment with which to de-conflict information in order to improve command and control. The Assistant Secretary of Defense for Networks and Information Integration informed his staff that this type of environment required a capability to communicate, collaborate, translate and engage in order to share unclassified information more readily with a view towards increasing the overall effectiveness of the US response (Ackerman, 2006). This presented a true dichotomy since command and control of forces is performed and coordinated in a largely classified environment. Whereas this sought after collaborative information environment was necessarily an unclassified environment given the diversity of the actors and their roles. This paper discusses the evolution of the emergent DOD unclassified information sharing enterprise service.

First and foremost the Unclassified Information Sharing (UIS) Enterprise Service (ES) that is emerging today is continuously evolving. This is an attractive aspect of the UIS in that the DOD must have a responsive, flexible, methodology to implement industry best practices and cutting edge solutions. Implementing a fixed UIS Enterprise Service would have the opposite result. Indeed if we are to aspire to Agile C2 as defined by Alberts & Hayes (2007, p.168), this necessitates the incorporation of novel techniques into the UIS that will enable a broader range of options for engaging a larger body of potential mission partners outside of the United States (US) military network domain that is also known as the “dot mil” network enclave.

At this juncture is imperative to underscore that the UIS Enterprise Service is not a C2 system. However, the information gleaned through collaboration and coordination in this environment can be leveraged to de-conflict C2 decision-making outside of this virtual environment. Alberts (2010, p.43) provides a framework for understanding emergent C2 characteristics called the NATO NEC C2 Model. In this model, Alberts explores the various types of command and control characteristics that one might experience across a complex operational continuum. As the DOD considers these characteristics to inform its next generation C2 systems, it is becoming clear that any future C2 systems will be reliant upon the information coordinated in the UIS environment to achieve the broadest possible situational awareness for decision makers. Therefore, the authors contend that there exists a correlation between developments in C2 systems and developments in information sharing and collaboration capabilities such as the UIS services.

2. Early Unclassified Web Presence

It is helpful to examine where the Department began its journey into UIS considerations. In the early 2000s, the USPACOM created a Website in order to share information with its multinational partners as a part of its Multinational Planning Augmentation Team (MPAT) sponsored by its J7 (Tempest, 2011). The Website was primarily a file sharing and military exercise tracking tool. Publicly releasable information was published to it in order to keep exercise participants up-to-date on the current status of the exercise. Over time, the Website took on more portal-like features including a log-in and password for access control as well as reserving more operationally sensitive, yet still unclassified information, for MPAT members. This Website was known as the Asia-Pacific Access Network (APAN). With the occurrence of the Indian Ocean Basin Tsunami, the Website took on a greater significance as it emerged as the only mechanism of its kind to facilitate the de-confliction of such a diverse set of responders. The Website eventually was transformed into a nominal Microsoft Sharepoint portal where a wide variety of information was shared all with a view to de-conflict or at

least to coordinate planned actions in the International USPACOM environment.

3. Transnational Information Sharing Cooperation (TISC) Joint Concept Technology

Demonstration (JCTD)

The Transnational Information Sharing Cooperation (TISC) Joint Concept and Technology Demonstration began in fiscal year (FY) 2007 and will transition to a shared enterprise service some time in 2011. It implemented nascent social networking practices, capabilities, and concepts in a portal environment that fosters a climate of information sharing amongst U.S. military, U.S. Government (USG) and other less traditional mission partners such as the United Nations and Non-Governmental Organizations (NGOs) (Transnational, 2009). This JCTD had the financial sponsorship of four regional Combatant Commanders. These included the United States Southern Command (USSOUTHCOM); United States Pacific Command (USPACOM); United States European Command (USEUCOM); and the United States Africa Command (USAFRICOM). In the context of significance, these commands have areas of responsibility that regionally extend across a majority of the surface of the Earth. It can be summarized then that the military commanders representing operations conducted around the world outside of North America are sponsoring research, with their respective Research and Development funds, to improve information sharing within the US Interagency and with non-traditional mission partners. Additionally funding has been allocated to have this capability transition from a technology demonstration platform to a shared enterprise service that can be made available to each of the Combatant Commands to support their unclassified operations. In terms of discrete capabilities included in the environment, one can expect to find wiki, blog, chat, translation, geo-spatial information tools, file lists, advanced search, word cloud maps, single sign on, Really Simple Syndication (RSS), Simple Message Service (SMS) and Multimedia Messaging Service (MMS) integration.

As of this writing there are two primary portal capabilities extant. Harmonieweb is a US Joint Forces Command portal that has a list of capabilities nearly on par with the USPACOM-based solution resulting from the TISC JCTD effort. The Defense Information Systems Agency, in concert with USJFCOM and the ASD(NII) / DoD CIO, is developing a transition strategy to consolidate these two solutions into a shared enterprise service without disrupting support to ongoing operations.

To recap then, imagine the degree of agility afforded to a Geographic Combatant Command (GCC) staff enabled by such tools and capabilities in conjunction with policy authorities to engage in operations with a wide variety of non-traditional mission partners in the unclassified dot org environment. When critical issues are coordinated or collaborated upon, the resulting information pertaining to control of the operation on the dot mil can then be shared with those military forces assigned to the operations from the dot org network environment.

4. From a JCTD to an Enterprise Service

The Office of the Secretary of Defense (OSD) Director for Cost Assessment Program Evaluation (CAPE) published a Resource Memorandum Decision – 700 that directs DISA to implement the Unclassified Information Sharing Enterprise Service for the Department. The DoD CIO organization vetted and approved the requirement and has endorsed the transition of the JCTD concept to an Enterprise Service. In the process, the TISC JCTD earned the Department of Defense’s “Transition Team of the Year” award for 2010 and the “Excellence in Intergovernmental Collaboration Award” for 2011. Plans are underway to instruct the Enterprise to utilize this Service and to forego any further development of similar technologies. In this way, the DoD CIO organization is fulfilling its Clinger-Cohen Act responsibility to achieve information technology efficiencies across the Department.

5. Policy Compliance, Oversight, and Planning for an Agile UIS

In keeping with Net-Centric policy (Assistant, 2004) the ASD(NII) in October 2008 convened a

Stability Operations Community of Interest (COI) to establish a clear road map to improve information sharing for Stability Operations. Over the course of 12 months, the COI examined multiple cases studies, formed a clear statement of the problem, and generated a high level capability roadmap (Christman, 2009). From this roadmap, a pilot demonstration working group was formed to craft a pilot demonstration. In September 2009, the pilot demonstration was conducted to illustrate the ability to share semantically aligned, doctrinally structured, food, water, and shelter assessment reports from a notional field location involving internally displaced persons in an Humanitarian Assistance / Disaster Relief (HA/DR) scenario. This information was ingested into the HarmonieWeb portal and displayed in a map view using Keyhole Markup Language (KML). In addition, through a Mediation Service, the data were published to a nominal Army Battle Command Server (ABCS). It was then ingested into a Maneuver Control System (MCS) client in Joint Consultation Command and Control Information Exchange Data Model (JC3IEDM) format. In this way, the data were also postured for ingestion by Alliance C2 systems developed in compliance with NATO STANAG 5525 and the Multilateral Interoperability Program. What emerged from this pilot demonstration was a clear conceptual model for a comprehensive approach to civil-military information sharing (Christman, 2010). This conceptual model is represented by figure 1.

Comprehensive Approach to CIM Information Sharing

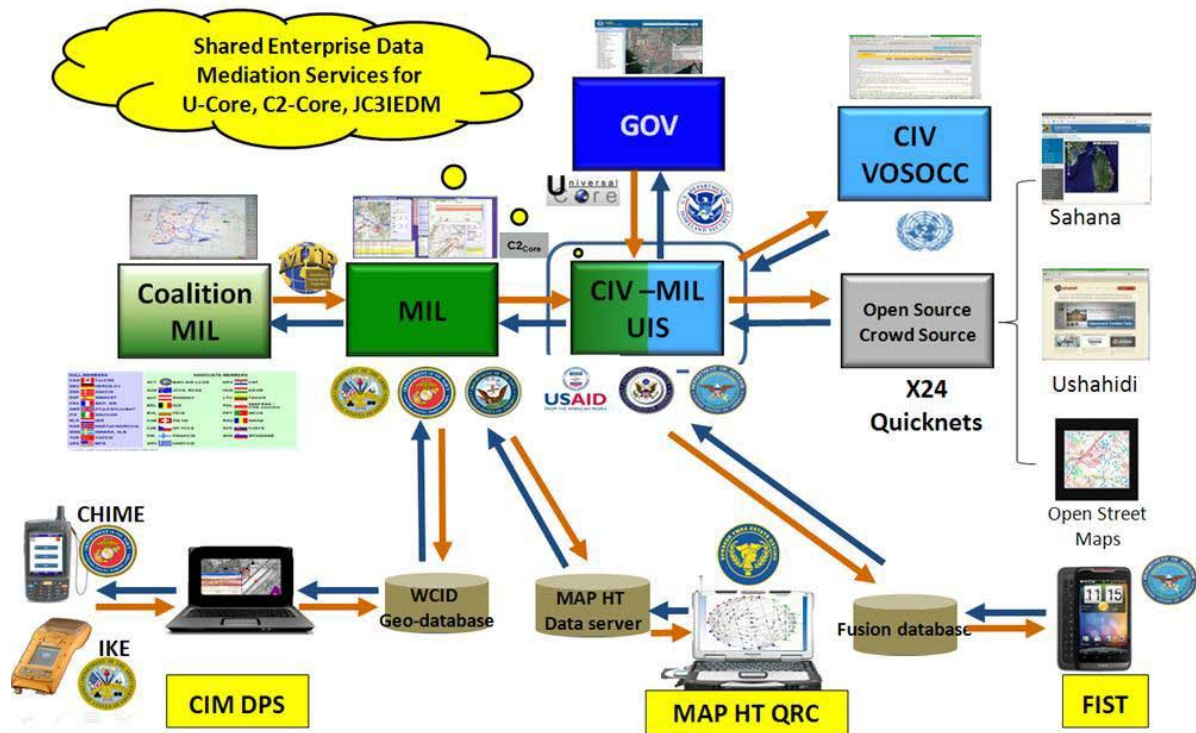


Figure 1. A conceptual model of a comprehensive approach to CIM information sharing (Christman, 2010).

The conceptual model takes into consideration the findings made available by the Director, Operation Test & Evaluation (DOT&E) on the Joint- Civil Information Management (JCIM) Joint Test & Evaluation (JT&E). This produced a Techniques Tactics and Procedures (TTP) Handbook for Civil Information Management (CIM) that standardized the assessment methods and information management business processes (J-CIM, 2010). As of this writing the J-CIM test was concluding and referring its findings into the Joint doctrine development process.

In addition, the US Special Operations Command (USSOCOM) approved the establishment of a Program of Record (POR) for a system to aid in the collection, management, and analysis of CIM. The system, the Civil Information Management Data Processing System (CIM DPS) is based largely on the processes established in the J-CIM TTP. It is being implemented at the 95th Civil Affairs

Brigade (Airborne), Ft Bragg, North Carolina with Initial Operational Capability scheduled for 2011.

The JCTD process also produced the Mapping Human Terrain Quick Reaction Capability (QRC). A Quick Reaction Capability is a capability that can be examined for two years in order to map out a cogent transition strategy following a JCTD. The strength of the capability is that it brings together a number of analytical tools to aid in the in-depth examination of socio-cultural link analysis amongst key actors in social networks. The JCTD concluded in September 2009 and continues as a QRC under the sponsorship of Headquarters Department of the Army, Deputy Chief of Staff for Intelligence, G2. Army G2 plans to migrate the MAP-HT capabilities into the Distributed Common Ground System – Army (DCGS-A) cloud using the OZONE Widget Framework where they will become part of the Army Standard Cloud architecture (D. Walsh, personal communication, May 31, 2011).

The Marine Forces Pacific Experimentation Center had conducted several experiments with a commercial off the shelf (COTS) approach to gathering medical and health records during Medical Readiness and Training Exercises (MEDRETE). The COTS solution employed the use of Motorola Personal Digital Assistants (PDAs) to capture patient and medical treatment information (Hamill, 2010). The information was then centrally managed at the field location and centrally uploaded to a contractor facility for archiving and analysis. This Civil and Humanitarian Information Management-Expeditionary (CHIME) architecture included the use of high-cost International Maritime Satellite (INMARSAT) service and is not considered optimal by the Marine Corps. Given the relatively large number of on-hand quantities of the Motorola PDAs, OASD(NII) recommended to the Marines that the USSOCOM CIM DPS software be loaded and that the Marines simply leverage the CIM architecture to submit their assessment data as an interim solution. The long term goal is a truly Joint Program that leverages the strengths of the CIM DPS system. To that end, a Capability Definition Package (CDP) is in staffing for presentation to the Joint Requirements Oversight Council.

Lastly, with regard to field-based assessment tools, the Field Information Support Tool (FIST) is a Smartphone “app” based approach to collecting assessment data that also relies on the J-CIM TTP (Longley, 2010). It has been used in trials in the Philippines, Afghanistan, and in the capstone Special Forces exercise called ROBIN SAGE. It is being managed by the Counter Narcotics Technology Program Office, Dahlgren, Virginia. The data are gathered in the field and then published to a centralized server facility in northern Virginia. The data can then be analyzed and geospatially rendered in order to gain a multidimensional representation of the area of interest. The objective system for ingestion of this data is the UIS. A beneficial aspect to this approach is that this tool leverages the commercial cellular network infrastructure as a primary pathway for transporting the data from the field location to the UIS. Imagine a unit tasked with responding to a Complex Endeavor that lacks a robust organic military network capacity. The CIM DPS, CHIME, and MAP HT approaches will all integrate their data to either C2 or Intel Programs of Record (POR) (i.e., DCGS-A, Command Post of the Future, Maneuver Control System, etc.). These POR all rely on a fairly robust military communications presence to function. If, early in an operation, that military communications network infrastructure has not arrived or been completely established, the FIST approach provides a suitable alternative route to get field-based assessments integrated rapidly into the architecture. Integrated FIST reports also provide a scalable solution in that the comparatively low cost and ease of use could be factors in a decision to scale the use of these tools in order to get more frequent field updates on the condition of facilities, engagements, relief requirements, etc. This integration work is being done in conjunction with the Cooperative Security Engagement JCTD. An initial demonstration of this technology is scheduled for early June 2011 with the objective to have most of the capabilities fully integrated into the UIS environment by the Operational Demonstration in October 2011.

In summary, the COI-based conceptual model serves as the investment and integration roadmap; the JC3IEDM-based Mediation Service represents a standard data model; the UIS Enterprise

Service represents a standardized portal environment using an industry-based Service Oriented Architecture (SOA); the assessment reports and information management methods represent standardized doctrinally-based business rules; and the field-based devices represent standardized methods of leveraging the dot mil and dot org environments in which to publish assessment reports.

6. The Way Ahead

Given the conceptual model as a roadmap and the standardized approaches for assessing, collecting, managing, and sharing the CIM data, one can see how the UIS serves as a bridge in effect, between the dot mil environment and the dot org environment. Similarly, the US dot mil environment serves as the bridge to the NATO Alliance and potentially a Coalition for Complex Operations. It is the authors' contention that the UIS is also poised to serve as a pivotal platform in which to implement a semantically aligned ontology for CIM by leveraging the work begun under the C2 Core pilot program and the U Core data model effort. Just as the mediation service as discussed above can serve to publish content in JC3IEDM format for Allied consumption, the mediation service can also be developed, as was demonstrated in the Stability Operation COI Pilot, to mediate to U Core or C2 Core format (Christman, 2010).

It is also a pivotal platform upon which to explore the notion of creating data marts in order to implement intelligent agent based technologies and improved data mining methods (Chisolm, 2007). This may lead to improved opportunities to expose or consolidate legacy databases that have served as authoritative data sources for many years as stand-alone, un-integrated, stove-piped data silos (Daniel, Goh, & Yusop, 2007). The purpose of this is to arrive at data that is machine readable and that can be ingested into services as a function of a Service Oriented Architecture (SOA). In addition, the Department should desire to develop Business Intelligence (Hammergren & Simon, 2009, p. 116). That is not to say Military Intelligence. Business Intelligence is that information about which Web Services are being utilized, what data is being pulled, from where, and when; when are members

logging in, how long do they stay, and other statistics or information that help determine how the Services being offered are meeting the needs of the responding community. In this way, there can be a cross walk to cost as well that ensures that the cost of the Web Services are in line with the volume of traffic, the number of users, and the degree to which the Services are enabling operations. This will make possible an executive level assessment in term of Clinger-Cohen Act equities such as performance and results based management of IT (Clinger, 1996).

7. Filling Information Gaps

Experience in responding to the Haitian Earthquake has taught us that we can expect there to be gaps in our information that prevents us from knowing how to best apply our relief resources in the most effective and efficient manner. Figure 2 (GDACS, 2011) illustrates that early in the response timeline, there is a high information demand yet there is a lack of recent-relevant post-disaster information available with which to plan relief efforts. A fairly new phenomenon emerged in Haiti called crowdsourced crisis response (Hester, Shaw, & Biewald, 2010). In short Hester et al. (2010) found that "Crowdsourced crisis response harnesses distributed human networks in combination with information and communication technology (ICT) to create scalable, rapid communication systems that promote well-being, survival, and recovery during the acute phase of an emergency." Given this, one can see how this can be a useful phenomenon with regard to filling in the gaps in knowledge in order to plan then execute operations. Furthermore, it can be used to de-conflict activities between the military the host nation, and the variety of responding organizations all poised to render their intended relief or aid.

The San Diego State University Visualization Center organized an experiment called X24 in September 2010 and again in March 2011 where a Balkan Humanitarian Assistance Disaster Relief scenario was used to experiment with a wide variety of participants and technologies to share information shape the response. "The purpose of X24 Europe is to conduct a robust virtual online

exercise that demonstrates the effective use of social media, crowdsourcing and collaboration tools in an innovative and cost-effective cloud computing environment. The exercise will focus on the exchange of actionable real-time information and build partner organizations' awareness regarding response to simulated humanitarian assistance and disaster relief (HA/DR) crises in the European theater." (Exercise, n.d.)

The conceptual model includes a crowdsourced aspect as shown in Figure 1. where Ushahidi, Sahanna, and Open Street Map illustrate how crowdsourced information can be published to the UIS environment thereby contributing content that serves to increase situational awareness. Envision then, the crowdsourced information being published into the UIS environment in order to increase the information available so that its curve more closely approximates the information required curve (see Figure 2.). Cell phones with SMS capability are nearly ubiquitous and can enable this crowd to eagerly fill in the information gaps as was the case in Haiti (Hester et al., 2010).

There are aspects to this that require additional research. First and foremost is the issue of vetting the information before it is published to the UIS environment. A technique that may be helpful in this regard is to use an interim portal like Ushahidi or Sahana to aggregate SMS reports. A business rule may be applied where after so many messages from different sources about one topic, a decision should be made to consider the topic valid and to publish the geo-spatially tagged data to the UIS. A secondary issue with this technique is the lack of structure in the SMS message field and the lack of a common lexicon. It may take many SMS messages before what is being reported becomes clear and even longer to determine how to take action to mitigate it. Lastly, by using an intermediate portal like Ushahidi for example, it provides some measure of defense in terms of security between the Crowd and the UIS. The intermediate portal would provide the DoD a buffer from malicious activity and provide the crowd with a buffer from the DoD thereby contributing to a sense of trust and/or comfort. It must be noted at this point that malicious activity has been extremely rare in these situations but every new

situation warrants a risk assessment to determine how best to treat urgent reports from the Crowd.

During the Haitian earthquake response, urgent crowdsourced reports actually resulted in lives being saved (McKenna, 2010; Vericat, 2010).

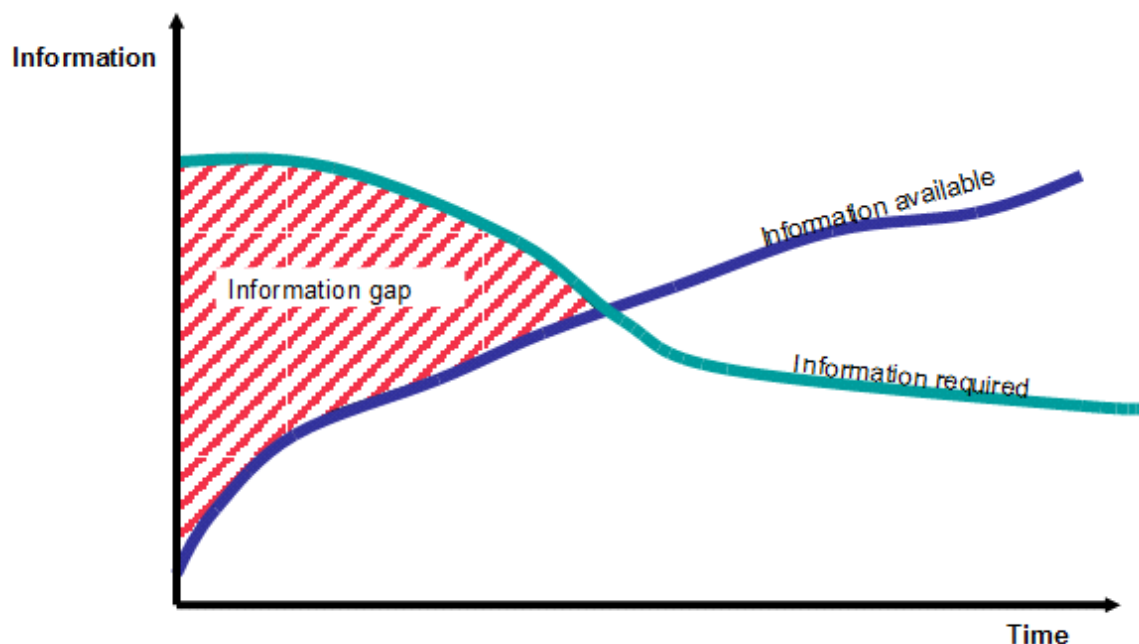


Figure 2. illustrates that immediately following a disaster, there exists a high demand for current relevant information yet there is a dearth of such (GDACS, 2011) information from mobile phone SMS gateways has been proven helpful in filling the information gap.

In a sense, these intermediate portal environments actually can be viewed as a way to build a bridge to the UIS and the US Military. It may afford all parties sufficient stand-off distance to foster the necessary “comfort zones” that enable trusted interaction from an information assurance perspective. Figure 3 below illustrates this notion of an interim organization serving as a bridge and filter.

Overall, the use of crowd sourced information has tremendous potential as was seen in Haiti, however, Euchner (2010) provides a concise list of conditions for consideration for their use: “1) The problem (and its boundary conditions) must be well defined; 2) The population of potential solvers with relevant expertise must be large, 3) Feedback must be provided to the crowd (not just to individual contributors) so that ideas can evolve, 4) Mechanisms for managing intellectual property

must be in place, and 5) Someone needs to filter the ideas (and develop them).

Crowd, Bridge, Transaction, Feedback Model

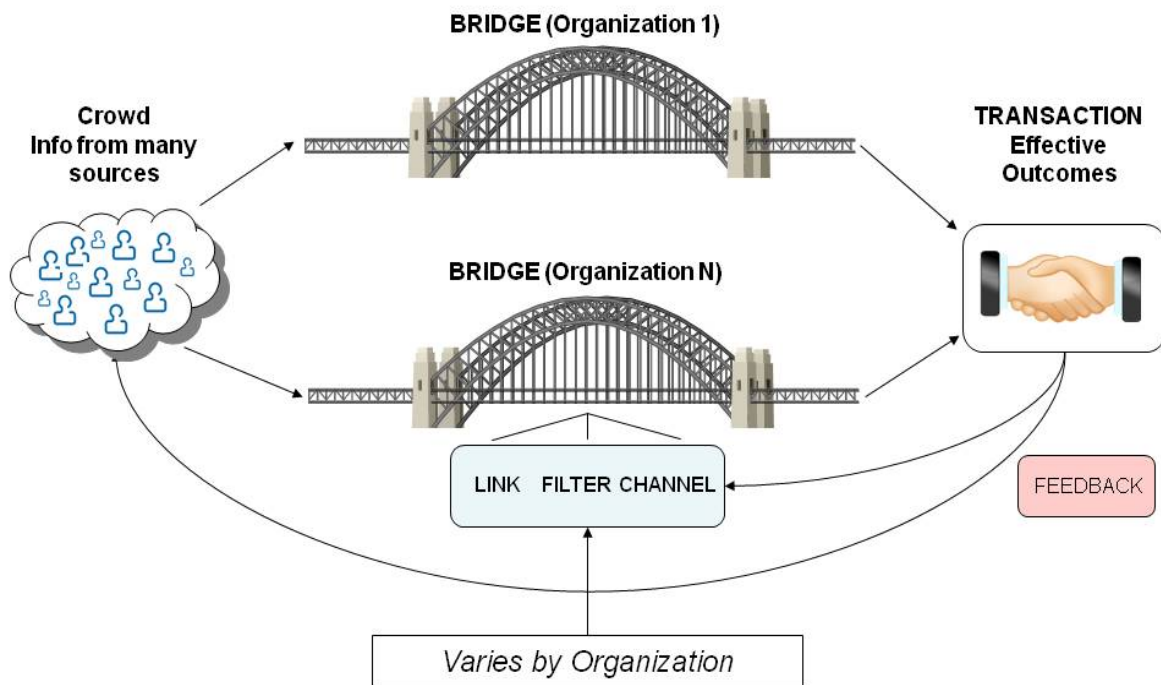


Figure 3. Crowsourced information filtered through a bridge organization such as Ushadidi or Sahanna can be an effective way to obtain the most relevant crowsourced information and mitigate risk (Ali & Wells, 2011).

Atkinson & Moffat (2005, p 180) describe the agile military headquarters of today as one that acts more as a part of a Community of Interest. Therefore, when couched in terms of the conceptual model complete with its bridging qualities to a broader range of stakeholders including coalition partners, IOs, NGOs, and other Governmental agencies; the US military would in effect be a member of a Community of Interest in keeping with Atkinson & Moffat's description of an Agile Organization.

8. Summary

From its humble Web 1.0 beginnings supporting limited USPACOM-specific purposes, the

Asia-Pacific Area Network (APAN) took on a greater prominence respecting the role it played in sharing information in response to the Indian Ocean Basin Tsunami. It afforded the DoD opportunities to learn valuable lessons and to expose critical gaps in the Department's ability to share unclassified information with a broad range of mission partners. It underscored just how highly sought after this sort of capability was by the Combatant Commanders. Coincident to this was the ascendancy of the Semantic Web and Social Networking applications that transformed the Web user's experience to one where there was more user participation in contributing to the knowledge and information being shared. Web 2.0 saw the emergence of Wikis, Chat, Blogs, language translators, Word Clouds etc. that enhanced the user's experience and empowered them to be contributors of their intellectual capital as one would expect in the Information Age (Stewart, 2001, p. 5; Hendler, Shadbolt, Hall, Berners-Lee & Weitzner). The DoD invested in technology demonstrations and implemented these technologies to permit a collaborative approach to engagement in operations with non-traditional mission partners. These technologies have opened up the possibility for better cooperation between the DoD and organizations such as the UN Office of the Commissioner for Humanitarian Affairs (OCHA) and the World Food Program. Alberts & Hayes (2003, p. 234) discussed the notion that true transformation is not solely a function of technological advances but also institutional and cultural. Wentz (2006, p. 25) discussed at length the nature of the cultural challenges, the lack of understanding, and the distrust that have occurred in the past when the US military engaged in disaster relief and stability operations. Cultural shifts are indeed occurring where some of those participants who were previously averse to collaborating with the DoD regarding Humanitarian Affairs have begun to collaborate, promote de-confliction and afford the military headquarters with unprecedented degrees of agility. With additional investments in a normalized ontological approach, in emerging technologies, in training, and in refined business practices, the UIS of tomorrow is poised to be a major enabler of 21st century military command and control.

References

- Ackerman, R. K. (2006, March). Intelligence Center mines open sources. *Signal*, 60(7).
- Alberts, D. S., & Hayes, R. E. (2004). The way ahead. In *Power to the edge* (p. 234). Washington DC: CCRP. (Original work published 2003)
- Alberts, D. S., & Hayes, R. E. (2007). Maturity models. In *Planning: complex endeavors* (p. 168). Washington DC: CCRP.
- Ali, K., & Wells, L., II. (2011, April 20). Crowdsourcing and collaborative tools in virtual online disaster relief scenarios [Web log post]. Retrieved from Armed With Science: <http://science.dodlive.mil/2011/04/20/crowdsourcing-and-collaborative-tools-in-virtual-online-disaster-relief-scenario/>
- Assistant Secretary of Defense (NII). (2004). *Data sharing in a net-centric Department of Defense*. Washington DC: (Department of Defense Directive 8320.02).
- Atkinson, S. R., & Moffat, J. (2005). Back to the future. In *The Agile Organization* (p. 180). Washington DC: CCRP.
- Chisolm, M. (2007, December). The twin towers of BI babel. *DM Review*, 24-28.
- Christman, G. J. (2009, October). Data sharing in a Stability Operations Community of Interest: Utilizing a pilot program to prove concepts and develop trust. *Proceedings of the 12th Annual Systems Engineering Conference*. Retrieved from <http://www.dtic.mil/ndia/2009systemengr/8788WednesdayTrack8Christman.pdf>
- Christman, G. J. (2010, June 24). On facilitating Stability Operations: A Net-Centric, Federated approach to information sharing . In *15th International Command and Control Research and Technology Symposium*. Retrieved from http://www.dodccrp.org/events/15th_icrts_2010/html_post_conference/index_post_conference.html

Clinger Cohen Act, 40 U.S.C. § 1425 (1996 & Supp. 1999).

Daniel, J. D., Goh, K. N., & Yusop, S. M. (2007). Data Transformation Service (DTS) creating data mart by consolidating multisource enterprise operational data. *International Journal of Computer Science & Engineering*, 1(3), 207-211.

Euchner, J. A. (2010, September/October). From the Editor [Special section]. *Research-Technology Management*, 53(5), 7-8.

Exercise 24 Europe. (n.d.). Retrieved May/June 23, 2011, from San Diego State University Visualization Center website: <http://x24.eushare.org>

Hamill, M. (2010, July 13). Volunteers use high tech PDAs in humanitarian effort [Web log post]. Retrieved from Good: <http://www.good.is/post/volunteers-use-high-tech-pdas-in-humanitarian-effort-1/>

Hammergren, T. C., & Simon, A. R. (2009). An intelligent look at business intelligence. In *Data warehousing for dummies* (2d ed., p. 115). Hoboken NJ: Wiley.

Hendler, J., Shadbolt, N., Hall, W., Berners-Lee, T., & Weitzner, D. (2008, July). Web science: an interdisciplinary approach to understanding the Web. *Communications of the ACM*, 51(7), 60-69. doi:10.1145/1364782.1364798

Hester, V., Shaw, A., & Biewald, L. (2010). Scalable crisis relief: Crowdsourced SMS translation and categorization with Mission 4636. *Proceedings on the First ACM Symposium on Computing for Development*.

Joint test director. (2010). *Joint civil information checklists* (Version 2.0 ed.). MacDill AFB: J-CIM JT.

- Longley, C. T. (2010). *Field Information Support Tool* (Master's thesis, Naval Postgraduate School, Monterey CA). Retrieved from <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA531590>
- McKenna, C. (2010, June 30). Homeland Security and Public Safety. In *Social network adds situational awareness to Haitian earthquake response*. Retrieved May 25, 2011, from <http://www.emergencymgmt.com>
- Stewart, T. A. (2001). The theory of a knowledge business. In *The wealth of knowledge* (p. 5). New York: Currency.
- Tempest Express* [Fact Sheet]. (n.d.). Retrieved May 22, 2011, from Global Security website: <http://www.globalsecurity.org/military/ops/tempest-express.htm>
- Vericat, J. (2010, Fall/Winter). Open source mapping as a liberation technology. *Journal of International Affairs*, 64(1), 195-201.
- Wentz, L. (2006, July). *An ICT primer: information and communications technologies for civil-military coordination in disaster relief and stabilization and reconstruction* (Monograph No. 31). Washington DC: Center for Technology and National Security Policy, National Defense University.